Project/Problem Based Learning in Electrical Engineering, IT and Automation

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Abstract
Inclusion of mini projects within a course is usually practiced at all levels in most of the universities/ university colleges with different names (such as course works, term assignments, projects, case-projects etc.), and appropriate weights with respect to the course credits. In the context of this paper, these assignments are called case-projects (CP), as they are often case studies conducted as projects. Usually such an assignment will be given to a group of 3 to 4 students during the term with working form based on some aspects of PPBL (Problem/Project Based Learning). Three different cases are presented in this paper from three different intuitions in Germany, Poland and Norway. A summary of student and teacher experience from these institutions is also presented. The model of case projects included in a normal course (5 to 10 ECTS) in Electrical, IT and Systems & Control Engineering is compared with a full-fledged group project (20 ECTS) run in University College of Southeast Norway, which is tuned to generate new entrepreneurial ideas, which were presented in European arenas in the context of Student Enterprise and Young Entrepreneurs. Brief technical descriptions of three different projects are also discussed. Case projects can be used as catalyzers for injecting new ideas, form and content to courses in general, as found in the studies of such practices in the two nation study involving three institutions.
Keywords – PBL/PBBL, Case-projects, innovations, entrepreneurship, Vocational trade certificates, Y-Vei

1. Introduction

This paper presents some pertinent issues related to the inclusion of PBL/PBBL in engineering curricula as practised in one German (JUAS), one polish university (TUL -Technical University of Lodz, Poland) and two Norwegian higher educational institutions (BUC). This is not a study on pedantic usage of PBL/PBBL, which can be seen in institutions running courses purely based on PBL/PBBL. We look into the various stages and relevant aspects of PBL/PBBL and how these can be exploited for setting realistic and relevant learning goals and achieving appropriate learning outcomes in the collaborative efforts by the teachers and students practising a learning model using some elements of PBL/PBBL.

PBL/PBBL has been extensively used by the medical faculties around the world. Within Scandinavia, Roskilde University (RU) and Ålborg University in Denmark have a long tradition in the usage of PBL/PBBL. Ålberg University is seen as a trendsetter for PBBL. Similarly, TUC has strongly supported project work with interdisciplinary features since 1982. In TUC, the interdisciplinary nature has been stressed in the faculty of technology. In BUC, elements of PBL/PBBL are found in semester assignments in the Faculty of Engineering involving projects in engineering designs and IT projects.

Some of the background information on the emergence of PBL/PBBL in the engineering discipline can be found in [1, 2, 4, 5]. The PBL approach is discussed with some interesting comments in [4] as applied to political sciences! The usage of PBL in chemistry and biochemistry is discussed with some good discussions in [6, 7]. Encouraging interest in science and maths as practised in Norway is discussed in a paper from the so called ROSE project is discussed in [8]. The different views from users of PBL/PBBL approach can be found in [9:11] among others.

2. PBL/PBBL – Pros and Cons

Traditional learning environments and students/staff involved in such environments were obsessed with problems and their solutions where the answers were unique and mostly given. In PBL/PBBL, the solution (answer) may not be unique and certainly not available at the beginning.

A combination of teacher-student classes, projects and practical problems is found to be attractive to the students and can help to define appropriate learning goals and set "measurable" learning outcomes, involving all aspects of engineering related to a given case study, encompassing hardware/software, design, testing and implementing the solution in a real life scenario, either in the industry or in the lab. This would stimulate students and make them interested in the topics and their sphere of influence/applications. This approach creates a platform for students' independent thinking and innovativeness and leaves imprints on the students by engaging many facets of the topics covered during the studies by the students and the staff involved in the process.

Pros	Contras
Students learn to plan their own work and to do research and organise themselves. The teacher stands outside and is ready to guide and help.	Suddenly getting a project work can be quite overwhelming for students who haven't been exposed to it. The teacher should take special care that the student comes through the planning and organising phase with satisfaction.
Students get a good preparation for later life, they will not always have their teacher to "feed" them with information	Special care should be taken of students who are doing this first time and are used to being fed by the teacher
Students learn to be more independent	May cause some 2spells" insecure moments. Teacher and technical staff should be always available for support/advice
There is a great chance the student learns more in a project, where he/she has to do all the research. This knowledge is not easily forgotten, whereas some of the information one otherwise learns at school is easily forgotten.	There is also a chance the students don't learn much at the project, either because they didn't succeed doing the planning and organising phase, or because the responsibility lies on their own shoulders, without a teacher to control them.
Students develop more interest to the subject the minute they have to organise their work and research themselves.	In extreme cases, the teacher may deliver a cook book recipe like material to the students. This can lead to boredom and indifference among students.
Collaboration with others and with people with different technological background	Demanding at times for weaker students
Students learn techniques related to project work (such as planning, meetings, minutes of the meetings, setting milestones etc.)	Demanding tasks for the teacher particularly when weak students form the majority of the project group
Students learn how to interpret different kinds of information sources, and to filter out reliable information	Different information sources can easily confuse students and the result may be that the students really can't get a grip on the subject.
Students learn to plan and to follow the plan/schedule and to deliver progress reports in project meetings or web-based reporting	Needs well organizes meeting schedules and web-platforms for information diffusion
Students get a chance to show their innovative talents	Necessary hardware/software support should be available without failure.

Table 1. Pros and cons of PBL/PBBL

Inclusion of PBL/PBBL in the curricula and involvement of and good interaction with relevant partners/sections of the industries can be of good "value" for both the students and the staff of both industries and the academia. This interaction has been referred as the "SIA2 triangle, Fig. 1. The advantages of such an interaction based PBL/PBBL is schematically illustrated in Fig. 2.

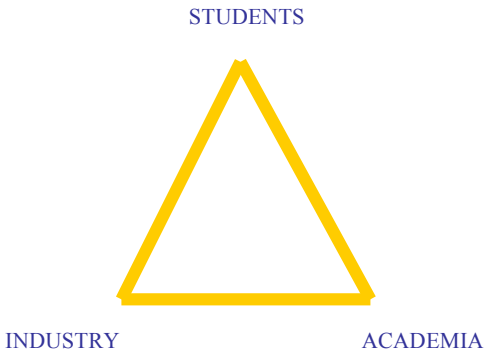

Figure 2. The importance of SIA triangle in PBL/PBBL. SIA triangle essentially opens up the path for candidates with vocational trade certificates. More on this in Section 6 in this article.

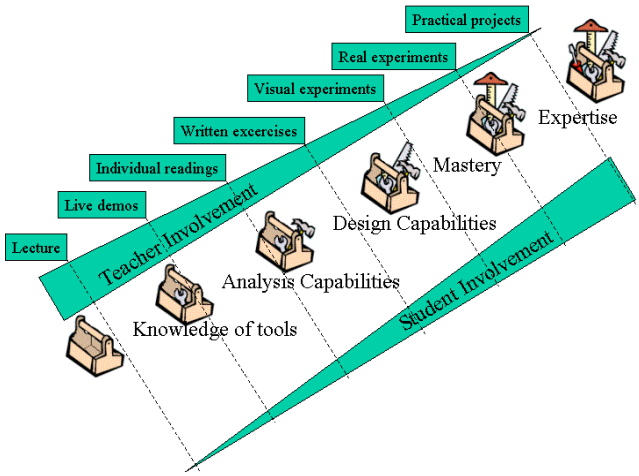

Figure 2. The advantages of SIA triangle in PBL/PBBL showing the process from knowledge base to expertise. From [4]

3. Practice of PBL/PBBL using term assignments in BUC

In BUC, some elements of PBL/PBBL are found in the term assignments given to students in the Department of Computing, Mathematics and Physics of the Faculty of Engineering. The assignments are projects to be worked on in groups of 2-4 students, where the teachers have a supervisor role.

Some examples of courses in the Faculty of Engineering and Business Administration, containing PBL/PBBL elements are listed in Table 2 below.

Course Code	**Topic**	**ECTS**	**PBL/PBBL weight**	**Weight towards final mark**
DAT104	System Development and Web Applications	10	30%	None
DAT154	Software Architecture and Application Development	10	30%	30%
ELE129	Offshore instrumentation and PC Based Data Collection	10	30%	40%
MOD250	Advanced Software Technologies	10	40%	40%
MOD251	Modern Software Development Methods	10	30%	None
DAT190	Bachelor Project	20	100%	100%

Table 2. Elements of PBL/PBBL in BUC in selected courses (Not exhaustive list)

Similar approaches are used in many of the topics covered in the Faculty of Engineering and Business Administration at BUC. Some of the term assignments are based on the model based on SIA triangle, while others do not contain explicit link to industry.

Pertinent observations related to the term assignments and their assessments and impacts on students can be summarized as follows:

- For several of the courses the final grade is based on the grades obtained in the written exams and weighted incorporation of the grades obtained for the term assignments. In some of the courses the projects are compulsory assignment to support learning, where the projects are only evaluated as passed, not counting towards the final grade
- The DAT190 course – the Bachelor project – is almost always running real projects from industry, and is entirely PBL/PBBL based, having hardly any lectures, but regular reports and presentations, facilitating the process of coaching and following up the project groups on a regular basis.
- The PBL/PBBL projects are found at both Bachelor and Master level of the IT education
- Some students performing rather weak in the written exam will do much better in PBL/PBBL project settings, and even get much improved overall grades due to the grades in their respective term projects
- Due to intensified focus on term assignments, some students may feel that their focus on other subjects offered during a particular term may be less intense
- Term assignments are sometimes interdisciplinary

The projects, whether being from industry or not; whether counting towards the final grade or not, all give the students valuable experience in teamwork, and in solving problems themselves. This is different from programmed exercises following the lectured material closely, by demanding much more independent research work from the students. In all cases the projects will be supervised, either by a faculty member or by industry contacts, or both.

Students put a lot of effort into PBL/PBBL projects, and find them much more interesting than standard assignments, which are often rather artificial. They also learn more from this kind of work, and enjoy it more.

Companies employing IT students graduating from BUC report that they master team work very well, and become productive fairly quickly. This is most likely due to the experience they have got from the PBL/PBBL projects performed during their IT education.

4. Practice using projects in JUAS

The examples presented here is from one of the Universities of Applied Sciences in North Rhine-Westphalia, which is the most populous state in Germany. University of Applied Sciences were founded in the 1960's. The Universities of Applied Sciences in Germany offer Management, Electrical Engineering, Mechanical Engineering, and IT and some of these offer also Civil Engineering, Architectural Engineering, Social and Health Sciences.

General strategy in JUCAS as found in similar institutions in other neighbouring regions is to start with PBL/PBBL approach somewhat later in the studies, the reason being the need for the students to acquire the fundamental concepts in basic sciences and engineering concepts before they launch on projects. As a result, elements of PBL/PBBL are first found from the fourth term onwards, so that the students can use of broader knowledge base obtained during the earlier terms. The topics discussed here partly covered in the webpages cited below, [17:21].

4.1 Project Engineering /Management

Students following Engineering Management has a spectrum of topics covering ~ 40% Engineering, ~40% Management and ~20% Integration of both disciplines. As the students need to be tuned to tackle problems involving engineering and management decisions, the projects defined do frequently have components from both disciplines. In fact, the project is a component of the curriculum as shown in Fig. 3

4.2 Extension to International Projects

Starting some decades ago and now with increasing intensity, all the courses offered in the higher educational institutions strive to have international components/links. With this in mind, the courses in Engineering Management in Germany, belonging to the top export oriented countries, are designed to have international components in most of the courses offered.

Anlage 1.1: Modulkatalog Wirtschaftsingenieurwesen - 29.09.2009

Module, Prüfungsleistungen, Studienleistungen, Kreditpunkte und Gewichtungen für die Bachelor-Prüfung gemäß §§ 6,7 und 8 Teil A BPO

Pflichtmodule	Semester	Arten von Prüfungen (§ 8 Teil A)	Kredit-punkte
Mathematik 1	1	K2	7
Grundlagen der Ökonomie	1	K2	5
Externes Rechnungswesen	1	K2	4
Kommunikationskompetenzen 4)	1	KA oder K2	4
Grundlagen der Technik	1	K2	5
Technische Mechanik 1	1	K2	5
Mathematik 2	2	K2	5
Statistik	2	K2	5
Informatik 1	2	K2	5
Investition und Finanzierung	2	K2	5
Wissenschaftliches Arbeiten	2	KA oder K1	2
Zeit-/Konflikt-/Selbst-Management 4)	2	KA oder K1	3
Technische Mechanik 2	2	K2	5
Informatik 2	3	ED oder K2	5
Organisation und Führung	3	K2	5
Qualitätsmanagement	3	K2 und EA1)	5
Fertigung	3	K2	5
Thermo- und Fluiddynamik 1	3	K2 und EA1)	4
Elektrotechnik 1	3	K2 und EA1)	6
Organisation und Führung Seminar	4	KA	2
Kosten- und Leistungsrechnung	4	K2	5
Internationales Projekt	4	KA1)	2
Thermo- und Fluiddynamik 2	4	K2 und EA1)	6

Figure 3. Project as an integral part of the curricula

In projects, it is mandatory that every group has an international partner. Very often, our partner organization in the Netherlands is involved in such PBL/PBBL based work. Sometimes, other international partners are also involved. The project is run by each partner institution sending and receiving 50% of the groups from each other. The language used in conjunction with the project is English. These projects are mandatory for all students in engineering management and are supervised by two professors, one with engineering and the other with management background.

4.3 Details on international Projects

The PBL/PBBL component of the Project Engineering/Management should facilitate the students to tackle and solve complex problems from Engineering Management with interdisciplinary elements, involving real life industrial/engineering scenarios, with focus on technical, economical. environmental and social implications of the project. The project needs to be presented in a solution oriented form in a report and should be presented in a forum involving students, staff and industrial partners. The project group is self-managed and should disseminate information on the outcomes and methodologies of the project and help to train any future users of the outcomes of the project, The presentation in a forum should help the students to learn to tackle time and peer pressure and the process as a whole is planned to help the soft skills needed by an engineering manager.

Technical Knowhow	25%

Economical Knowhow	25%
Management knowhow	25%
Analysis and Integration of the whole	25%

Table 3. Elements of other Disciplines in PBL/PBBL as used in JUAS

4.4 Some recent projects at JUAS

Some recent projects done by the students of JUAS and Netherlands are:

- Planning a Windmill park – Technical and Economic Aspects
- Planning a Heat Pump based power station- Technical and Economic Aspects
- Different Real Life problems from Logistics

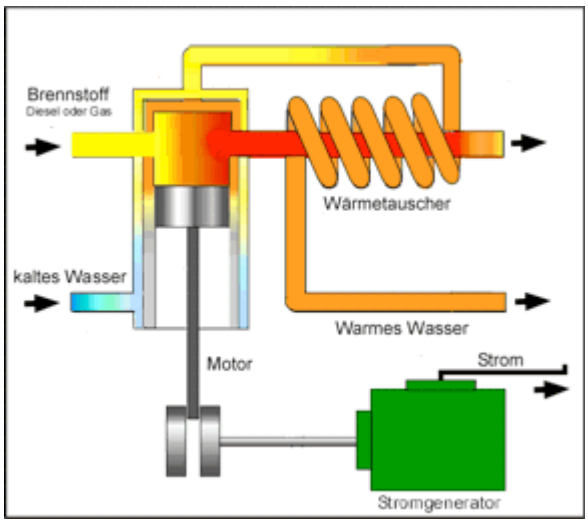

Figure 4. Heat Pump based power station as a case study used by students of JUAS reflecting the current technological and socio-political trend in the energy market

Figure 4. Wind Mill Park as being observed by German Chancellor Angela Merkel. Wind farms are currently very much in focus in Germany and hence the case studies in the form of projects in Germany.

The PBL/PBBL element in the curricula appears in the fourth term as indicated in Fig. 6.

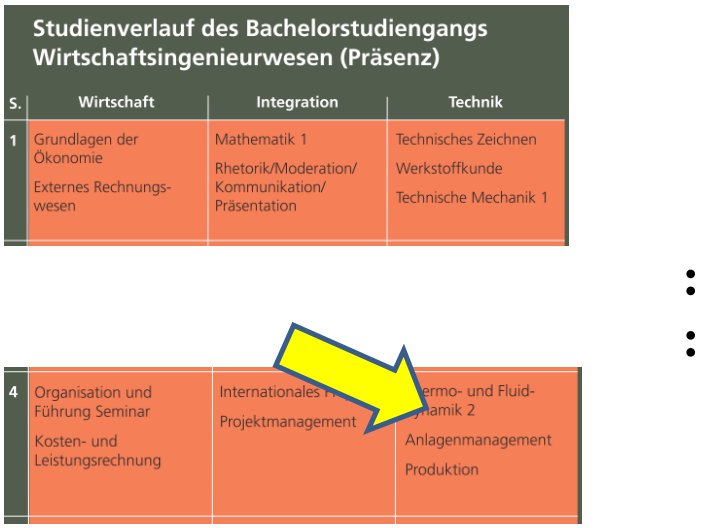

Figure 6. PBL/PBBL approach in the fourth term at JUAS

5. Case Projects in USN

PBL/PBBL elements in a course needs some form of collaboration with fellow students and with the SIA-triangle model also between students, staff in the academia and experts in the industries, possibly involving the usage of dedicated hardware/software encountered in the project. As a group, one learns a lot more than as an individual, particularly in most of the engineering disciplines. The knowledge levels achievable in different learning scenario are schematically presented in Table 4.

Achievement (Knowledge) Level	Level
Level achievable when the student collaborates with someone **(LEVEL 3)**	
Level achievable when the student works alone **(LEVEL 2)**	
Present Level **(LEVEL 1)**	

Table 4. Knowledge levels (schematic)

A closer tie to the industrial partners usually enhances the performance of all three members in the SIA triangle of Fig. 1. Interesting aspect of the SIA golden triangle is that the process has a tremendous synergy that the level enhancement is mutual in a positive SIA working relationship. The benefits of co-operative learning are discussed in [2, 3] and our belief is that these benefits are not only at individual student level but also at the level of organisations.

5.1 Case Projects at USN in Spring Term 2016

We give the list of case studies we took up in autumn 1999 in collaboration with different industries as part of a PBL/PBBL environment. The students discussed the problems with the teacher, the lab-engineers in the university and the technical experts in the various industries. The students following the lectures were all invited by some of the firms to visit the facilities and to discuss the issues with technical personnel at site before they decided to select the projects.

A selected group of subjects at bachelor and master levels using PBL/PBBL approach is given in Table 5.

Course Code	Topic	ECTS	PBL/PBBL weight	Weight towards final mark
SCE1213	Hard/Soft Sensors in Process Measurements (Master)	10	20%	20%
SCE2006	Industrial IT (Master)	10	30%	30%
SCE4206	Systems and Control Laboratory (Master)	5	30%	40%
SCE1106	Control with Implementation (Master)	10	40%	40%
FB6115	Tverrfaglig prosjektarbeid (Interdisciplinary Project)	10	30%	None
FB5312	Studentbedrift (Student Enterprise)	20	100%	100%

Table 5. Elements of PBL/PBBL at USN in selected courses (Not exhaustive list). Bachelor studies in USN are all in Norwegian. Hence the original names of courses in Norwegian.

In conjunction with the course "Hard/Soft Sensors in Process Measurements", PBL/PBBL methods are used in solving problems from or relevant to the industries covering sensing to data fusion and implementing soft sensing methodologies. The course on "Industrial IT" deals with IT solutions needed in different industrial scenarios. In the course "Control with Implementation", practical control solutions are developed for a given system, with a cross-disciplinary approach. The course "Interdisciplinary Project" at bachelor level, looks into interdisciplinary engineering projects guiding the first and/or second year students to learn the different aspects of running a project. The course "Student Enterprise" is a concrete endeavor with a group of students working with the PBL/PBBL approach in innovating new products leading to the establishment of companies to market these new innovations. Students from HSN have been successful in competing in different EU arenas dealing with different approaches to motivate students to become entrepreneurs.

Company	Project
Ulefos Jernværk	(1) A study of sand mould Anomalies
Ulefos Jernværk	(2) Detection of Molten Metal Freezing/leakage in flow of smelts
Emerson Process Management	(3) Usage of DCS based on DELTA V for control Processes

Table 5. Case Projects taken up for the subject "Soft Sensors". DeltaV based PBL/PBBL activity is part of the collaborative project between TUL and USN

This case project is part of the course "Systems and Control Laboratory", but also some projects about this topic has been performed in a third semester project course. At USN we have established different weather systems for presenting the weather at university. One of the weather system uses a Capricorn 2000EX Weather Station from Columbia Weather Systems. Another weather system uses an AWS 2700 Weather Station from Aanderaa/AADI, developed by a series of PBL/PBBL activities during the past few years. Important part of the case projects using these systems have been to interface them in order to get data from the systems and store them in an OPC server or an SQL Server database, Fig. 7. Details of modules and programs described below can be found in [13:15],

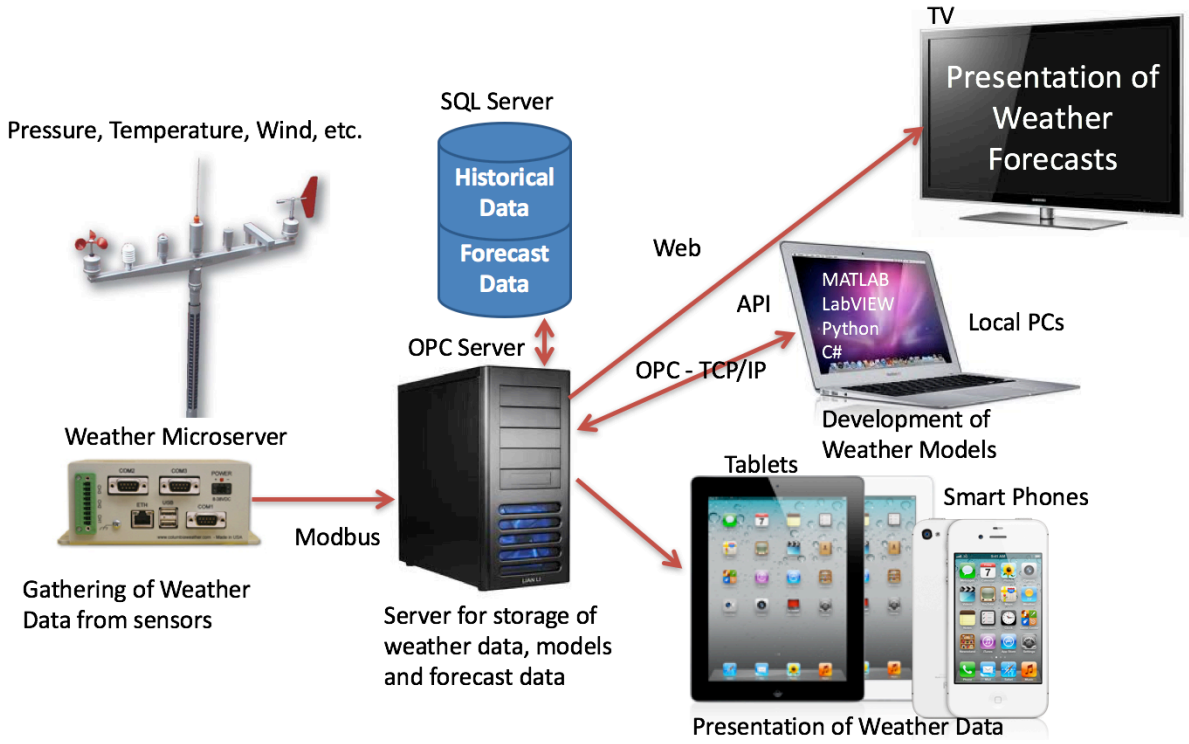

Figure 7. Weather monitoring and forecasting system at its present stage after a series of PBL/PBBL assignments to different student groups at bachelor- and master- degree levels.

While other weather systems have been developed from scratch using components and devices such as Arduino Raspberry Pi and myRIO from National Instruments, With myRIO students can create the applications with ordinary LabVIEW programming, well known for the students at HSN, and then download the application to the myRIO device so it runs as an embedded system without having a PC connected to it.

With Arduino students typically use the Arduino IDE creating their own applications, while with Raspberry Pi students typically create their programs with Python, by installing a Linux OS on the device. If the students install and use Windows 10 IoT Core, they may use Visual Studio and C# programming. With myRIO from National Instruments, students will naturally use the LabVIEW programming environment.

With Arduino, Raspberry Pi and myRIO, students can connect and use a variety of sensors. Some of the following cases are explored in this case project:

- Design and Implement a Database for storing Weather Data.
- Log Weather Data. Publish Data using OPC (Create an OPC UA Server).
- Get Data from the OPC Server (OPC UA Client) and Save Data to the Database (stored on your local PC).
- Weather Monitoring
- Create Models for Weather Prediction. Use MATLAB for Data Analysis, etc. Predict, e.g., the Weather Tomorrow (e.g. Temperature) based on the Model(s)

In one of the case projects a UWP (Universal Windows Application) application was developed. The application is available in Windows Store on Windows 8 and Windows 10 computers.

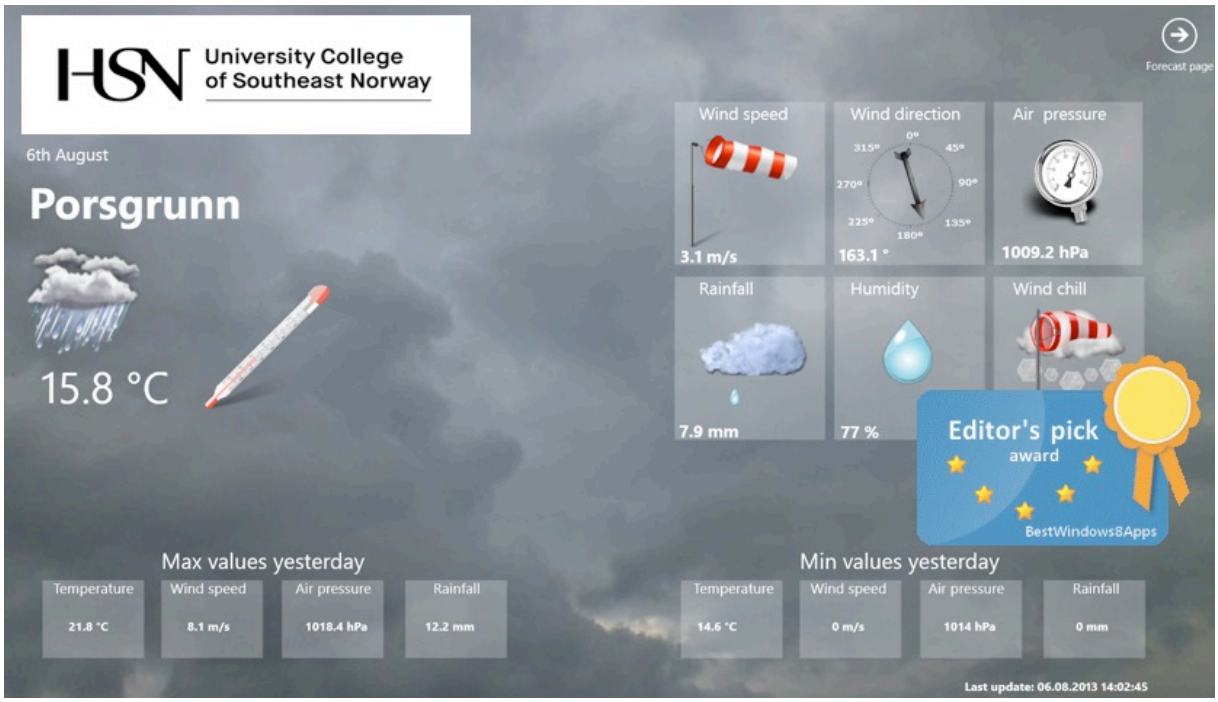

Figure 8. Weather Monitoring Example, PBL/PBBL achievement: App tested and rated by the BestWindows8Apps.net. Awarded as "Editor's pick award". More details in [16].

The solutions made in one of the case projects was also awarded as best application in its category. The App has been tested and rated by the BestWindows8Apps.net. The App is awarded as "Editor's pick award". Some of the topics are covered in weather system case projects are:

- Industrial IT
- Databases (SQL)
- OPC
- Embedded Systems, Real-Time Systems
- DAQ, Data Logging
- Modelling
- LabVIEW/MATLAB Programming
- Visual Studio and C# programming

More PBL/PBBL based activities and outcomes from them are discussed in [16].

5.2 Learning by doing

This exercise of learning by doing implicitly involved in PBL/PBBL, gave the students many positive challenges and opportunities because of the following points:

- Learning to work in groups.
- Students were given various tasks in collaboration with the industry, thus learning the communicating methods used in the industry.
- Students had to learn about the industrial process and environment
- Students had to follow industry procedures in handling chemicals, materials and equipment.
- Students had to be creative and find solution to their problems and choose appropriate sensors, having the technical and economic aspects always in mind.
- Some of the students decided to run some tests, just to verify that their solution worked

- Write a report.

The most positive aspect with this “learning by doing” with this kind of project, is that students in a group had the induced possibility to be creative, which would have been almost impossible to achieve in this form in traditional teacher centred learning environment.

5.3 Motivation in PBL/PBBL and final examination

The set of goals of the project in the context of PBL were: to learn about practical problems, sensors, security routines, and communication and to gain an overall understanding of the subject. By using practical work one could achieve this set of goals more efficiently. The model, we have used here can also enhance the learning of theory via practical work in the industry.

The examination form has also a lot to do with the motivation for the different ways of learning. If the examination has a dominant focus on theoretical knowledge, the students won't be motivated to do laboratory and practical work with the same eager.

The examination was based on the report and oral presentation of the project description and results from the activities of the members of the project group PBL/PBBL.

6. Y-Vei and Student Enterprise at USN

6.1 Y-Vei (Vocational Path) at USN

“Y-Vei” (Y-path, Y stands for “Yrke” – ~Vocation, hence “Y-Vei – Vocational Path” for higher studies) is a Norwegian word indicating a path to higher education in Universities or University Colleges based on formal vocational training with adapted training in subjects like Mathematics and Physics/Chemistry in the respective universities before admitting the candidates with vocational training to higher studies. The Y-vei is a specially designed study programme for students with trade certificates / apprenticeships making the path to bachelor or master degrees in selected fields appropriate to their vocational training. . During 3 years, these students can achieve a bachelors engineering degree and if they choose to do so, they can continue to study for a master degree following a 2-year master programme in their specialities.

USN, commenced a nationally supported pilot project on recruiting Y-Vei, candidates holding a relevant trade certificate to USN’s electrical engineering undergraduate program in 2002. Before 2002, vocational school graduates used one academic year or more for mastering the traditional mix of subjects Mathematics, Physics, and Language (seen as mandatory knowledge base) to be considered eligible for admission in Norway. In 1994, the Ministry of Educations in Norway introduced a rather revolutionary reform, at least from the Norwegian perspective, making at high school level vocational trade certificate and normal secondary school leaving certificates to be considered *on par* when it comes to university entrance requirements. Viewing vocational trade and secondary school leaving certificates as equivalent, has led to a plethora of such “Y-Vei” courses in many of the University Colleges in Norway, with a dominance in engineering disciplines, [22].

This model was practised in USN for a long time and has been very successful and the candidates are very often valued highly by the industries, particularly because of their experience with PBL/PBBL based education at USN. Although the terminologies PBL/PBBL are not explicitly used in all the courses designed for the Y-Vei students, all the group based projects are very often.

In conjunction with some bachelor level courses, although involving some challenges, a combination of Y-Vei students and ordinary students coming direct from the secondary schools in PBL/PBBL based activities helps to enhance the learning outcomes for the "ordinary" students as well as for the Y-Vei students, as they have the role of imparting their practical knowledge to their peers, who lack their practical experience.

6.2 Student Entrepreneur at USN

Within the European Countries, there is a collaboration and competition in conjunction with "Young Entrepreneurs". This is a concept used in educational environments to motivate innovations and entrepreneurship. Usually, the students start with a concept based on some novel concept focused on new product development and innovation with a definite goal of establishing an enterprise at the end. The students go through all the steps involved in establishing an enterprise including economic planning, IPR-studies, handling personnel placements in the initial phases of the establishment of the enterprise. In such EU-competition, the Y-Vei students with or with some participation of "ordinary" students have always in the competitions nationally and at European level, many time winning the first prize. This overwhelming performance of the Y-Vei students is partly to be attributed to the PBL/PBBL approach they have in their curricula.

7. Conclusions

PBLPBBL based curricula in engineering curricula in collaboration with the industries are found in many universities, as are the cases from two University Colleges in Norway and one in Germany.. Encouraging the student involvement in the selection of topics right from the beginning using the SIA triangle and facilitating PBL/PBBL in relevant subjects can help to improve the learning process tremendously. The PBL/PBBL case projects conceived in collaboration with the industries for the evolving course content in an engineering curriculum in close collaboration with the academia and the students are fruitful for all involved and can even lead to innovations, which can lead to new enterprises, as the case studies involving the Y-Vei students of Norway show. The PBL/PBBL based learning are dynamic and helps to eliminate the recycling of course material and content very much prevalent in many academic institutions, either at secondary or university level.

The success of the PBL/PBBL arrangement and the establishment of enterprises are very much dependent on the interest and energy flow in the SIA triangle. Formalised agreements at the top are not enough to gain the most out of such SIA triangle. Experience shows that individuals with interest for synergy benefits in the SIA triangle can promote this endeavour, thus leading to better curricula and attractive engineers to the society as a whole.

The success with Y-Vie students predominantly working with ~PBL/PBBL based curricula endorses the importance of this approach in most of the engineering curricula. Experience shows that a dedicated course to the teachers involved in PBL/PBBL based activities can improve the quality of work and the learning outcomes. In addition, the holistic planning of course with and without PBL/ PBBL is of paramount importance to avoid unnecessary problems and at times even frustrating events impeding the progress of the planned work.

8. Acknowledgment

The collaboration with our industrial partners and the response of students related to our PBL/PBBL studies are very much appreciated. The mobility of student and staff between TUL and TUC/HSN was facilitated by the EEA project. Eivind Fjelddalen of USN has been very helpful in solving many of the engineering challenges in collaboration with the students involved in the PBL/PBBL tasks discussed in this paper.

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